

What is claimed is:

1 1. A mount suitable for passive-active vibration isolation in
2 association with variable loading, said mount comprising a first member
3 for attaching to a first entity, a second member for attaching to a second
4 entity, at least one streamlined resilient member, and at least one
5 structurally-positionally and functionally-directionally collocational
6 combination of a sensor and an actuator; each said streamlined resilient
7 element at least substantially consisting of an elastomeric material and
8 being interposed between said first member and said second member; each
9 said streamlined resilient element being characterized by low dynamic
10 load transmissibility of vibration in approximately the same frequency
11 bandwidth over a broad loading range; said at least one streamlined
12 resilient element thereby being capable of effectuating overall passive
13 reduction of the transmission of vibration from said first member to said
14 second member; said overall passive reduction being of vibration in
15 approximately the same first frequency bandwidth over a broad loading
16 range of said first entity; each said collocational combination having a
17 corresponding region of said second member; each said collocational
18 combination being capable of generating a sensor signal and an actuator
19 vibratory force; said sensor signal being representative of the local

20 vibration in the corresponding region and being representable as a control
21 signal; said vibratory force being representative of said control signal; each
22 said collocational combination thereby being capable of effectuating, in the
23 corresponding region, localized active reduction of the transmission of local
24 vibration which has reached said second member subsequent to the
25 effectuating of said overall passive reduction; said localized active
26 reduction being of vibration in a non-first frequency bandwidth which
27 differs from said first frequency bandwidth.

1 2. A mount as recited in claim 1, wherein at least one said
2 streamlined resilient element includes at least one truncation surface,
3 each said truncation surface adjoining one of said first member and said
4 second member.

1 3. A mount as recited in claim 1, wherein each said streamlined
2 resilient element at least substantially describes a shape which is selected
3 from the group consisting of sphere, prolate spheroid, cylinder, torus and
4 torus segment.

1 4. A mount as recited in claim 3, wherein at least one said
2 streamlined resilient element includes at least one truncation surface,

each said truncation surface adjoining one of said first member and said second member.

5. A mount as recited in claim 4, wherein:

said first member approximately describes a first plane;

said second member approximately describes a second plane which is approximately parallel to said first plane;

if said streamlined resilient element at least substantially describes a cylinder shape, said streamlined resilient element approximately defines a longitudinal axis which is approximately parallel to said first plane and said second plane;

if said streamlined resilient element at least substantially describes a torus shape, said streamlined resilient element approximately defines a longitudinal axis which lies in a third plane which is approximately parallel to said first plane and said second plane; and

if said streamlined resilient element at least substantially describes a torus segment shape, said streamlined resilient element approximately defines a longitudinal axis which lies in a third plane which is approximately parallel to said first plane and said second plane.

6. A mount as recited in claim 3, wherein:

2 said first member approximately describes a first plane;
3 said second member approximately describes a second plane which
4 is approximately parallel to said first plane;
5 if said streamlined resilient element at least substantially describes
6 a cylinder shape, said streamlined resilient element approximately defines
7 a longitudinal axis which is approximately parallel to said first plane and
8 said second plane;
9 if said streamlined resilient element at least substantially describes
10 a torus shape, said streamlined resilient element approximately defines a
11 longitudinal axis which lies in a third plane which is approximately
12 parallel to said first plane and said second plane; and
13 if said streamlined resilient element at least substantially describes
14 a torus segment shape, said streamlined resilient element approximately
15 defines a longitudinal axis which lies in a third plane which is
16 approximately parallel to said first plane and said second plane.

1 7. A mount as recited in claim 1, wherein said broad loading range
2 associated with said overall passive reduction is between a minimum load
3 value and a multiple load value of the minimum load value, and wherein
4 said multiple load value is between approximately ten times and
5 approximately one hundred times said minimum load value.

1 8. A vibration isolator which is adapted for engagement with a
2 processor/controller, said processor/controller being capable of generating a
3 control signal, said vibration isolator comprising:

4 a spring assembly which includes a top member for securing said
5 spring assembly with respect to an isolated entity, a bottom member for
6 securing said spring assembly with respect to an isolatee entity, and at
7 least one interposed streamlined resilient member, each said streamlined
8 resilient member being at least substantially composed of an elastomeric
9 material, each said streamlined resilient member having the property of
10 passively reducing vibration within a special passive-reduction-related
11 frequency bandwidth which is at least substantially constant when said
12 streamlined resilient member is subjected to a wide range in terms of the
13 degree of loading, said at least one streamlined resilient member thereby
14 being capable in net effect of passively reducing vibration within a general
15 passive-reduction-related frequency bandwidth which is at least
16 substantially constant when said streamlined resilient member is
17 subjected to a wide range in terms of the degree of loading which is
18 associated with at least one of said isolated entity and said isolatee entity;

19 at least one sensor, each said sensor being coupled with said bottom
20 member and being capable of generating a sensor signal which is in

21 accordance with the vibration in a local zone of interest in said bottom
22 member; and

23 at least one actuator, each said actuator being coupled with said
24 bottom member and being collocationally paired with one said sensor so as
25 to share approximate coincidence with respect to both physical situation
26 and operational direction, each said actuator being capable of generating,
27 in said local zone of interest of said sensor with which said actuator is
28 collocationally paired, a vibratory force which is in accordance with said
29 control signal, wherein said control signal is in accordance with said sensor
30 signal which is generated by said sensor with which said actuator is
31 collocationally paired, wherein said vibratory force has the tendency of
32 actively reducing vibration within an active-reduction-related frequency
33 bandwidth which differs from said general passive-reduction-related
34 bandwidth.

1 9. A vibration isolator as defined in claim 8, wherein said general
2 passive-reduction-related bandwidth is approximately commensurate with
3 said special passive-reduction-related bandwidth.

1 10. A vibration isolator as defined in claim 8, wherein at least one
2 said streamlined resilient element includes at least one truncation surface,

each said truncation surface adjoining one of said top member and said bottom member.

11. A vibration isolator as defined in claim 8, wherein:

to at least a substantial degree, each said streamlined resilient element has a shape which is selected from the group consisting of spherical, prolate spheroidal, cylindrical, toroidal and segmentedly toroidal;

said top member has a top member bottom surface which approximately defines an upper plane;

said bottom member has a bottom member top surface which approximately defines a lower plane which is approximately parallel to said upper plane;

if said shape is cylindrical, said streamlined resilient element approximately defines an imaginary central axis which is approximately intermediate and approximately parallel to said upper plane and said lower plane;

if said shape is toroidal, said streamlined resilient element approximately defines an imaginary central axis which lies in a third plane which is approximately intermediate and approximately parallel to said first plane and said second plane; and

19 if said shape is segmentedly toroidal, said streamlined resilient
20 element approximately defines an imaginary central axis which lies in a
21 third plane which is approximately intermediate and approximately
22 parallel to said first plane and said second plane.

1 12. A vibration isolator as defined in claim 11, wherein at least one
2 said streamlined resilient element includes at least one truncation surface,
3 each said truncation surface adjoining one of said top member and said
4 bottom member.

1 13. A vibration isolator as defined in claim 8, wherein said wide
2 range, in terms of the degree of loading which is associated with at least
3 one of said isolated entity and said isolatee entity, is approximately a
4 range which is between a minimum loading value and a maximum loading
5 value, said maximum loading value being between ten times and one
6 hundred times said minimum loading value.

1 14. A vibration isolation system; said vibration isolation system
2 being for reducing the transmission of vibration of a first entity to a second
3 entity; said vibration isolation system comprising a spring assembly and a
4 feedback loop system; said spring assembly being for effectuating global

5 passive vibration control; said feedback loop system being for effectuating
6 localized active vibration control subsequent to said effectuating of said
7 global passive vibration control; said spring assembly including a first
8 securement member, a second securement member and at least one
9 interposed streamlined resilient element; said first securement member
10 being for securing said spring assembly with respect to said first entity;
11 said second securement member being for securing said spring assembly
12 with respect to said second entity; said at least one streamlined resilient
13 member being essentially elastomeric; said at least one streamlined
14 resilient element passively reducing the transmission of vibration of said
15 first entity to said second entity; said passively reduced vibration existing
16 in at least a first frequency bandwidth; said first frequency bandwidth
17 being generally constant within a broad scope of the amount of loading
18 upon said at least one streamlined resilient element by at least one of said
19 first entity and said second entity; said feedback loop system including at
20 least one sensor, a PID-type controller and at least one actuator; said at
21 least one sensor being coupled with said second securement member; each
22 said sensor generating a sensor signal which is a function of the vibration
23 in a localized control area of said second securement member; said PID-
24 type controller generating at least one control signal which is a function of
25 said at least one sensor signal; said at least one actuator being coupled

with said second securement member; each said actuator generating, in said localized control area, a vibratory force which is a function of a said control signal; said at least one actuator, by said generating, reducing the transmission of vibration of said first entity to said second entity; said vibration existing in at least a second frequency bandwidth; said at least a first frequency bandwidth and said at least a second frequency bandwidth being generally dissimilar; said at least one sensor and said at least one actuator being collocated whereby each said sensor and one said actuator are approximately coincident and whereby the sensing of each said sensor and the actuation of the corresponding said actuator are approximately in the same direction.

15. The vibration isolation system according to claim 14, wherein at least one said streamlined resilient element at least substantially defines a spherical shape.

16. The vibration isolation system according to claim 14, wherein at least one said streamlined resilient element at least substantially defines a prolate spheroidal shape.

17. The vibration isolation system according to claim 14, wherein at

2 least one said streamlined resilient element at least substantially defines a
3 cylindrical shape.

1 18. The vibration isolation system according to claim 14, wherein at
2 least one said streamlined resilient element at least substantially defines a
3 torus shape.

1 19. The vibration isolation system according to claim 14, wherein at
2 least one said streamlined resilient element at least substantially defines a
3 segmented torus shape.

1 20. The vibration isolation system according to claim 14, wherein at
2 least one said streamlined resilient element includes at least one
3 truncation surface, each said truncation surface adjoining one of said first
4 securement member and said second securement member.

1 21. The vibration isolation system according to claim 14, wherein
2 said broad scope of the amount of loading approximately ranges between a
3 minimum loading amount and a maximum loading amount, and wherein
4 said maximum loading amount is approximately between ten times and
5 one hundred times said minimum loading amount.

1 22. Apparatus for both passively and actively isolating the vibration
2 of a structure situated over a foundation, said apparatus comprising:

3 a processor/controller;

4 a spring device which passively reduces the transmission of said
5 vibration from said structure to said foundation, said spring device
6 including an upper member for fixing said spring device with respect to
7 said structure, a lower member for fixing said spring device with respect to
8 said foundation, and at least one streamlined resilient element, wherein:

9 each said streamlined resilient element is elastomeric and is
10 so configured as to at least substantially exhibit the attribute of
11 effecting passive reduction of the vibration existing at least nearly
12 the identical frequency band over a significant range of the degree of
13 loading imposed upon said streamlined resilient element;

14 said significant range is between a minimum degree of
15 loading and a maximum degree of loading;

16 said maximum degree of loading is no less than about ten
17 times said minimum degree of loading;

18 said maximum degree of loading is no more than about one
19 hundred times said minimum degree of loading; and

20 said streamlined resilient element is so configured as to at
21 least substantially describe one of a sphere, a prolate spheroid, a

22 cylinder, a torus and a torus segment; and
23 at least one collocation of a sensor and an actuator wherein, for each
24 said collocation:

25 said sensor and said actuator are each coupled with said
26 lower member so as to be approximately identically located and
27 approximately identically directed;

28 said sensor senses the local vibration in a portion of said
29 lower member and produces an electrical sensor signal
30 commensurate with said local vibration;

31 said processor/controller receives said electrical sensor signal
32 from said sensor and produces an electrical control signal
33 commensurate with said electrical sensor signal; and

34 said actuator receives said electrical control signal from said
35 processor/controller and produces in said portion of said lower
36 member a vibratory force commensurate with said electrical control
37 signal, said vibratory force increasing the stability of said portion of
38 said lower member, said actuator thereby effecting active reduction
39 of the transmission of said vibration from said structure to said
40 foundation whereby, in succession, said spring device passively
41 reduces the transmission of said vibration and said actuator actively
42 reduces the transmission of said vibration.

1 23. The apparatus according to claim 22, wherein at least one said
2 streamlined resilient element is at least slightly truncated for facilitating
3 connection to said upper member.

1 24. A method for reducing transmission of vibration of a first entity
2 to a second entity, said method comprising:

3 providing a spring assembly which includes at least one streamlined
4 resilient member, an upper securement member and a lower securement
5 member, said at least one streamlined resilient member being essentially
6 elastomeric and being for passively reducing the transmission of vibration
7 existing in at least a first plurality of frequencies, said first plurality of
8 frequencies falling within a generally constant bandwidth in relation to a
9 range of loading imposed upon said at least one streamlined resilient
10 element by at least one of said first entity and said second entity, said
11 range being between a minimum degree of loading and a maximum degree
12 of loading, said maximum degree of loading being no less than about ten
13 times said minimum degree of loading, said maximum degree of loading
14 being no more than about one hundred times said minimum degree of
15 loading, each said streamlined resilient element being shaped so as to at
16 least substantially describe one of a sphere, a prolate spheroid, a cylinder,

17 a torus and a torus segment; and

18 engaging with said spring assembly a feedback loop system, said
19 engaging including:

20 establishing at least one collocation of a said sensor with a
21 corresponding said vibratory actuator so that said sensor and said
22 corresponding said vibratory actuator are each coupled with said
23 lower securement member at approximately the same location, and
24 so that said sensor senses and said corresponding said vibratory
25 actuator actuates in approximately the same direction and in
26 approximately the same locality of said lower securement member;

27 connecting each said sensor and each said vibratory actuator
28 with a processor/controller so that, for each said collocation, said
29 sensor generates a sensor signal representative of the vibration of
30 said locality, said processor-controller generates a control signal
31 representative of said sensor signal, and said vibratory actuator
32 generates a vibratory force representative of said control signal; and

33 providing power for said feedback loop system; and

34 mounting said first entity with respect to said second entity,
35 said mounting including fastening said first entity with respect to
36 said upper securement member and fastening said second entity
37 with respect to said lower securement member;

38 wherein, in series, said spring assembly effects passive reduction of
39 said vibration at said first plurality of frequencies, then said feedback loop
40 system effects active reduction of said vibration at a second plurality of
41 frequencies; and

42 wherein at least one frequency among said second plurality of
43 frequencies is not among said first plurality of frequencies.

1 25. A method for reducing transmission of vibration as recited in
2 claim 24, wherein said providing a spring assembly includes:

3 providing a streamlined resilient element which has a first
4 truncation surface and a second truncation surface opposite said first
5 truncation surface; and

6 joining said streamlined resilient element with each of said upper
7 securement member and said lower securement member so that said first
8 truncation surface abuts said upper securement member, and so that said
9 second truncation surface abuts said lower securement member.

1 26. A method for reducing transmission of vibration as recited in
2 claim 25, wherein said providing a streamlined resilient element includes
3 effecting said first truncation surface and effecting said second truncation
4 surface.